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Linking Specimens and Collectors - a Pilot Study (The Th. Angele Bird Collection and the Database ZOBODAT)

Gerhard AUBRECHT

Biology-centre of the Museum of Upper Austria, Linz/Austria

Abstract. The geographical database ZOBODAT (www.biologiezentrum.at) aims to contribute to the understanding of biodiversity by offering an interactive information system for scientists, nature protection and the public. Linking specimen data with biographical information about collectors is a new development towards this aim in order to provide as much interrelated information as available. The new possibilities presented lead the user from specimens to collectors and vice versa, thus giving insight into collection and collecting history, a field of natural history still poorly investigated.

The collection Th. ANGELE (museum of Upper Austria) comprises 1,473 specimens, mainly birds of prey and owls, collected between 1895 and 1925. It was chosen for this pilot study because of the world-wide origin of specimens and their widely distributed collectors. 49 out of 67 collectors' names could already be identified according to biographical sources. Still open questions will hopefully be answered when the whole system is run via the world wide web and therefore open to a wide forum of prospective contributors of biographical information.

Technical details concerning the database are presented.

Key words. Biodiversity database, bird collection, collection history, biographies, Th. Angele collection, Austria

1. INTRODUCTION

The biogeographical database ZOBODAT (www.biologiezentrum.at) aims to contribute to the understanding of biodiversity by offering an interactive information system for scientists, nature conservationists and the public (MALICKY & AUBRECHT 2001).

Historically biogeographical databases were developed mainly for the technique of plotting distribution maps. This goal has become especially important with the rise of biodiversity research as a focal conservation issue (BIBBY et al. 1992). GIS techniques now contribute to interpreting species distribution patterns on all geographical scales. Results increase with the availability of geographically based information layers comprising non-biotic and biotic parameters.

Museum specimen information systems have to deal with additional parameters linked to biological specimens like persons involved in collecting, determination and revision. The mode of preparation and type specimens must be documented as well.

Meanwhile discussions have started and prototypes are being developed for linking decentralized biodiversity databases on regional and global levels (The Species Analyst, Univ. Kansas, USA- www.habanero.nhm.ukans.edu/; ENHSIN – European Natural History Specimen Information Network – www.nhm.ac.uk/science/rco/enhsin/; ENBI - European Network of Biodiversity Information, European Union – www.faunaeur.org/enbi).

Common taxonomic reference lists available for all contributors will be one of the focal points for the future success of these projects (Species 2000 – www.sp2000.org/ and Fauna Europaea – www.faunaeur.org/).

By technical means, the world-wide-web already offers the communication medium as far as databases can provide the standards needed.

The aim of our pilot project was to link specimen data with biographical data in order to provide insight into collection and collecting history. Such information is urgently needed for interpreting and reconstructing historical collections and for better understanding the fate of individual specimens and the scientific information they contain.

For demonstrating the function and use of such links in a pilot project we used the bird collection Th. Angele and the database ZOBODAT, both located at the biology centre of the Museum of Upper Austria.

The development and testing of new database queries and links is also carried out within the frame of the European Union project ENBI.

2. BIRD COLLECTION THEODOR ANGELE

This collection comprises 1,473 specimens, mainly birds of prey and owls from all over the world, purchased by Theodor ANGELE from different collectors and dealers of natural history specimens between 1895 and 1925.

A special part of the „Angele-collection“ are bird specimens from Natal collected by A.G.J. RUDATIS. 331 specimens can be directly contributed to this collector (AUBRECHT et al., in print).

After ANGELE's death in 1926 the Museum of Upper Austria became care-holder of his collection in 1927 and bought it in 1941. Th. KERSCHNER, curator of the zoological collections, started to take into inventory and determinate all specimens (KERSCHNER 1942). In a big exhibition most of the specimens were presented to the public in Linz during October 1953 (KLOIBER 1953, 1954, 1955; TRATZ 1954). From this time until 1980 Mrs. G.Th. MAYER was curator for this collection and worked on improving the inventory-data and in preserving the specimens. All mounted specimens were screwed in wooden boxes and thus were well preserved during these decades.

Since the mid-1990s G. AUBRECHT, J. PLASS and S. WEIGL started to work on the collection. All specimens were re-investigated for proper determination together with A. GAMAUF and H. SCHIFTER (NHMW, Natural History Museum Vienna) by means of new literature, and data were digitized in a data-base. All information available originates from the original specimen labels and inventory books. Only very few correspondence of Th. ANGELE with collectors and natural history dealers could be found especially concerning sales negotiations when ANGELE wanted to dispose of his collection in the 1920s.

3. THEODOR ANGELE

*5.4.1847 Erolzheim, Württemberg, Germany, † 28. 6. 1926 Linz, Austria, studied at the Technical University in Stuttgart and started a career as railway engineer with numerous projects in the Austrian-Hungarian monarchy in 1869. 1871 he married J. RÖSSLER in Iglau (4 children). After his wife's death he married a second time in 1882, P. SCHWAB (4 children). As railway engineer he worked in Austria, Moravia, Bohemia, Silesia, Galicia, Hungary, Siebenbürgen, Bukowina and Romania (ASCHAUER 1964) and founded his own firm in 1875. In 1897 he started a co-operation with Th. HOCK (HOCK & ANGELE, Linz, until 1905).

From 1889 until 1893 he lived in Brno, Moravia (now Czech Republic), where he became member of the „Naturforschende Gesellschaft Brünn“ in 1891 (ANONYMUS 1892).

As an ardent hunter he began playing with the idea of composing a world-wide collection of birds of prey and owls in 1892. Since 1894 he kept his residence in Linz, Austria. From 1895 until 1915 (irregularly until 1925) he devoted his spare-time to building up his bird-collection, consisting mainly of birds of prey and

owls, using personal links and sales offers of natural history dealers all over the world. Th. ANGELE did not publish a single word about his huge collection.

4. DATABASE ZOBODAT

ZOBODAT (Zoological-Botanical Database, former ZOODAT) is a digitally organized biogeographical database including facilities for analysis, documentation and communication (MALICKY & AUBRECHT 2001; REICHL 1986; MALICKY 1998). Founded 1972 by Univ. Prof. Dr. Ernst Rudolf REICHL, ZOBODAT was taken over by the federal country of Upper Austria in 1999. It is now located at the Biology Centre of the Museum of Upper Austria.

The database comprises information about the temporal and spatial distribution of animal and plant species and various supporting information topics. Most of the data refer to insects taxonomically and to Austria geographically. But ZOBODAT can be used for all groups of organisms and world-wide. Besides plotting traditional distribution maps, new goals include user friendly analysis which enable rapid retrievals of information about certain geographical areas and site-specific conservation matters. Special user accounts provide a differentiated data protection.

A comprehensive survey about the recent structure of ZOBODAT is given by MALICKY & AUBRECHT (2001). Data for input can be provided on standardized lists or via desktop database-systems like MS-Access or dbase. Meanwhile people and institutions contributing to ZOBODAT have full access to their own data and to ZOBODAT's documentation programs via the internet by holding special user identifications.

Staff:

Biology: Dr. Gerhard AUBRECHT

Technical part: D.I. Michael MALICKY

Technical development:

IBM 1130 (1972-1975)

IBM 370 - Mainframe (1975-1993)

Software: TSO, PL/I, FORTRAN

Intel 80486 - Personal Computer (1993-1999)

Software: Windows NT, Oracle, PLSQL, C

Intel Dual PII 350 - Databaseserver, Intel PII 400 - Webserver (since 1999)

Software: Linux, Postgresql, Grass GIS, Apache Webserver, PHP

Table 1: Geographical and taxonomical contents of the database ZOBODAT: (online Top 10, Dec. 2001) AUT = Austria

Area	No. records	Taxa	No. records
Upper Austria, AUT	572,076	Lepidoptera	1,494,891
Lower Austria, AUT	386,378	Coleoptera	453,532
Carinthia, AUT	259,323	Hymenoptera	88,499
Tyrol, AUT	233,083	Trichoptera	58,788
Styria, AUT	213,316	Mollusca	47,976
Salzburg, AUT	184,886	Homoptera	22,802
Romania	101,172	Arachnida	17,462
Italy	93,972	Aves	8,189
Vorarlberg, AUT	93,944	Diptera	7,719
Burgenland, AUT	69,512	„Vermes“	7,562

5. PILOT STUDY - LINKING SPECIMENS AND COLLECTORS

The documentation of the collection Th. ANGELE is still progressing. For the pilot study names of collectors and natural history dealers have been identified on specimen labels. By literature study and the help of numerous colleagues biographic information of collectors has been gathered for gaining short biographies and available photos. Of course this process is a „never-ending“ one and a number of questions are still open concerning unidentified or poorly documented cases. In the near future this information will be freely accessible via the internet and will hopefully bring new biographical results.

Table 2: Collectors of Coll. Th. ANGELE with biographical information available

Collector	year of birth and death	selected literature source
Angele, Theodor	1847 - 1926	Kerschner (1942)
Barlow, Chester	1874 - 1902	Taylor (1903)
Blanc, Marius	1857- 1944	Horn et al. (1990)
Blohm, Wilhelm	1875 - 1944	Gebhardt (1964)
Boucard, Adolphe	1839 - 1905	Mearns & Mearns (1998)
Briceno, Gabaldon L.	?	Phelps (1944)
Dombrowski, Robert	1869 - 1932	Schuster (1933)
Dybowski, Benedikt	1833 - 1930	Gebhardt (1964)
Erlanger, C. V. Heinrich	1872 - 1904	Kleinschmidt (1905)
Fleck, Eduard	1841(3) - 1917	Gunn & Codd (1981)
Franke, Rudolfo	?	pers. comm. S. Eck
Fritsche, Karl	?	Archiv Biol. centre, Linz
Führer, Ludwig	1866 - 1937	Gebhardt (1964)
Garlepp, Otto	1864 - 1959	Niethammer (1972)
Geisler, Bruno	1857 - 1945	Gebhardt (1964)
Harvie-Brown, J. A.	1876 - 1955	Love (1982)
Henseler, Carl	1876 - 1955	Horn et al. (1990)
Herron, Robert Byron	1859 - 1943	pers. comm. R. Quigley
Hildebrandt, J. Maria	1847 - 1881	Schalow (1881)
Hoffmanns, Wilhelm	1865 - 1909	Gebhardt (1970)
Humblot, Leon	1852 - 1914	Horn et al. (1990)
Kellen, Veth	?	Reichenow (1902)
Kny-Scheerer	?	Horn et al. (1990)
Kühn, Heinrich	1860 - 1906	Hartert (1907)
Lano, Alberto	1860 - 1928	Stone (1928)
Meek, Albert Stewart	1871(2) - 1943	Mearns & Mearns (1998)
Molnar, Lajos	1853 - 1942	Keve (1939-42)
Palmer, Mervyn Grove	1882 - 1954	Horn et al. (1990)
Penther, Arnold	1865 - 1931	Kühnelt (1978)

Table 2 continued

Collector	year of birth and death	selected literature source
Platen, C. Constantin	1843 - 1899	Gebhardt (1964)
Price, W. Wightman	1871 - 1922	Fisher (1923)
Reed, Carlos Samuel	1888 - 1949	Etcheverry (1993)
Reischek, Andreas	1845 - 1902	Aubrecht (1995)
Rolle, Franz Hermann	1864 - 1929	Gebhardt (1970)
Rosenberg, W. F. Henry	1868 - 1957	Mearns & Mearns (1998)
Rudatis, A. G. Hans	1875 - 1934	Gunn & Codd (1981)
Schlüter, Wilhelm	1828 - 1919	Schmidt (1919)
Schlüter, Willy	1866 - 1938	Kleinschmidt (1938)
Schrader, Gustav	1852 - 1942	Gebhardt (1964)
Schwanda, Ferdinand	?	pers. comm. H. Schifter
Thompson, Seton Ernst	1860 - 1946	Palmer (1947)
Tancré, Rudolf	1842 - 1934	Gebhardt (1964)
Teichmann, Otto	? - 1941	Gerber (1939-1941)
Tschusi zu Schmidhoffen, V.	1847 - 1924	Gebhardt (1964)
Umlauff, J. F. G.	?	Horn et al. (1990)
Voelschow, A. D. K. Martin	1866 - ca. 1940	Horn et al. (1990)
Weiske, Emil	1867 - 1950	Heyder (1964)

Table 3: Collectors of Coll. Th. ANGELE with biographical information still unavailable

Collector	origin of specimen
Black, J.W.	N-America
Flickigg, E.	Siberia
Franklin, I.	N-America
Gamer, E.	N-America
Gebgardi	Russia
Gordon, Theodore	N-America
Guelf, G.F.	N-America
Krebs, A.	N-America
Leblanc, J.	E-Africa
Leizear	N-America
Lenssen, Robert	Brazil
Monthu, M.	N-America
Riedel, Georg	S-America, Ethiopia
Rodriguez, J.H.	Guatemala
Rostowsky	Venezuela
Schlegel (prob. not H. or R.)	S-America
Schnerrer	Cameroon
Witte Palob	Brazil
Wyszonirski, Ludwik	Russia

6. TECHNICAL PROCEDURE WITHIN THE DATABASE (D.I. M. MALICKY)

Within the database system ZOBODAT pathways were provided by linking relationally organized thematic files in order to gain easy access to related specimen information issues (Fig. 1). Most important was the possibility to enable the user to jump from species to specimen and to collector and vice versa and to combine this information with mapping the geographical components.

Example:

Query (1) for species *Buteo buteo*

Result: number of specimens referring to *Buteo buteo* (sub)species (Fig. 2), with possibilities for

- creating a list of specimens or
- map of listed specimens or
- link to NCBI-genbank

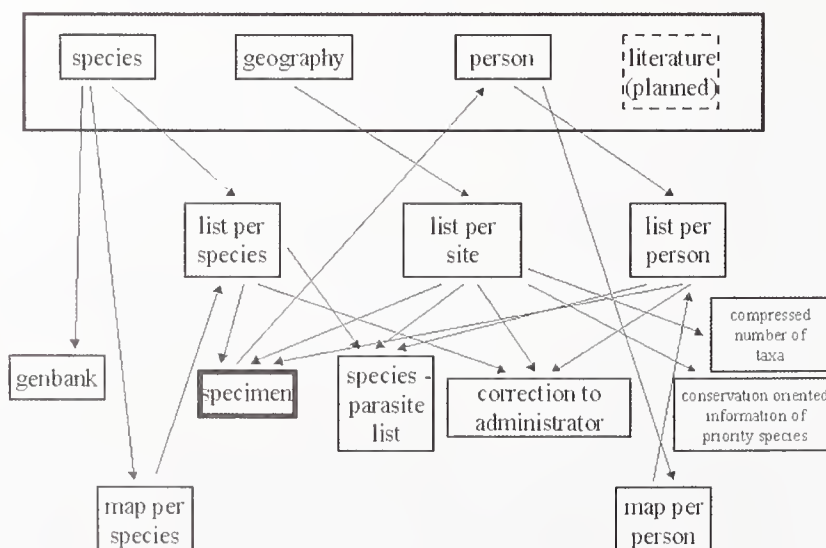


Fig. 1: Query pathways demonstrating the interactive functions and links within the database ZOBODAT, referring to species-related, site-related and person-related specimen information (M. MALICKY, Linz, Austria).

Stamm	Klasse	Ordnung	Familie	Gattung	Art	Unterart	Autor	Daten	Karte	NCBI Genbank
Chordata	Aves	Accipitriformes	Accipitridae	Buteo	buteo	arrigonii	Picchi, 1903	<u>1</u>	<u>X</u>	<u>Nucleotide</u>
Chordata	Aves	Accipitriformes	Accipitridae	Buteo	buteo	japonicus	Temminck & Schlegel, 1844	<u>3</u>	<u>X</u>	<u>Nucleotide</u>
Chordata	Aves	Accipitriformes	Accipitridae	Buteo	buteo	menetriesi	Bogdanov, 1879	<u>4</u>	<u>X</u>	<u>Nucleotide</u>
Chordata	Aves	Accipitriformes	Accipitridae	Buteo	buteo	vulpinus	Gloger, 1833	<u>2</u>	<u>X</u>	<u>Nucleotide</u>
Chordata	Aves	Accipitriformes	Accipitridae	Buteo	buteo		(Linnaeus, 1758)	<u>148</u>	<u>X</u>	<u>Nucleotide</u>

Fig. 2: Result of query 1: number of specimens referring to *Buteo buteo* (sub)species (ZOBODAT, Linz, Austria).

Query (2) for list of specimens referring to *Buteo buteo*

– to look at individual specimen information,
– parasite data, or

Result: list of specimens including collecting sites and dates (Fig. 3), with possibilities

– send correction of certain record information to
administrator

Czernavoda, Rumänien	RO	28° 1' 0"E 44°22' 0"N	-	13. 2.1900				E E K
Czernavoda, Rumänien	RO	28° 1' 0"E 44°22' 0"N	-	19. 6.1902				E E K
Czernavoda, Rumänien	RO	28° 1' 0"E 44°22' 0"N	-	.				E E K

Fig. 3: Result of query 2: Detail of list of specimens including collecting sites and dates (ZOBODAT, Linz, Austria).

Query (3) for an individual specimen from the specimen list

– determinant,
– reviser,

Result: names of person related to this specimen (Fig. 4) like

– collection

– collector,

with possibilities of looking at short biographies and
photos

Belegtext1:	
Belegtext2:	
Leg:	<u>Robert Ritter von Dombrowski, Linz bei Wien, Austria</u>
Det:	<u>Anita Gamauf, NHMW, Wien</u>
Rev:	
Lit:	
Conf:	
Coll:	<u>Theodor Angele, Linz, Austria</u>

Fig. 4: Result of query 3: names of person related to an individual specimen (ZOBODAT, Linz, Austria).

Query (4) for name collection Th. ANGELE

Result: short biography and photo of Th. ANGELE (Fig. 5), with possibilities to create

- list of all records of coll. ANGELE or
- map of all records of coll. ANGELE (Fig. 6)



Fig. 5: Result of query 4: Photo of Th. ANGELE (the short biography included in this query result is omitted here because already included in the text above) (ZOBODAT, Linz, Austria).

From this list one can again trace back to any individual specimen record.

Other query possibilities include searches for manually defined or pre-defined geographical regions with stepwise resulting site lists and specimen records.

For certain protected areas (pilot version) it is also possible to get compiled information of species or record numbers of higher taxa within chosen time periods (e.g. number of Piciformes species or records) or lists of priority species including the latest year of record.

Another query can start with names of persons, resulting stepwise in short biographies and lists of specimens referring to determinators, collectors or collections as shown above.

These interactive query functions are already installed in the database ZOBODAT and ready for further improvement and testing. In a next step we are going to include and to link literature sources to this system.

7. DISCUSSION

Including biographies into a biodiversity database is only one further step within the development of databases made possible by new technical improvements.

The history of biodiversity (historically biogeographical) databases shows interesting changes of paradigms. The first aim was to develop individual databases according to a wide range of taxonomic and geographical contents. Most databases tried to get monopoly status for certain taxa or regions. Nevertheless individual and technical developments led to a steady increase of newly founded databases mostly without consideration of common standards.

A change in thinking arose with the common availability of the world wide web's communication possibilities. Now it became apparently necessary to eval-



Fig. 6: Result of query 4: map of all located collecting sites referring to the collection Th. ANGELE. Collecting sites which do not exactly match geographical point information are included but not yet specifically made visible on this map by different symbols (ZOBODAT, Linz, Austria).

uate new means of data transfer and documentation between highly diverse databases on national and international levels. This development was especially driven by the global biodiversity initiatives which became politically established.

Plans for better communication and linking of biodiversity information arose and were pushed from institutions independently of database holders and without knowledge of their individual technical and administrative problems.

The new challenge was to develop common standards, technical facilities and the financial background for allowing the linking of decentralized databases.

The world wide web allows decentralized communication by offering nodes wherever technical possibilities are available. It is only because of political reasons that national nodes have been installed and are going to be developed for linking biodiversity information.

The database ZOBODAT has successfully tried to keep pace with these developments. Technical structures have been steadily improved and the aim to increase the data volume has still high priority. A basis was set for the input of all zoological and botanical taxa and for a global geographical reference allowing analysis and documentation of data. With internet suitability, the step for communication with related databases was logically prepared.

The volume of data input is mainly restricted by the time needed for scientifically recording and digitizing the data. Especially the GBIF (Global Biodiversity Information Facility) program deals with these problems common to all scientific biological collections.

Plans and pilot studies for linking biodiversity databases raise especially technical questions and are limited by administrative restrictions of individual databases.

Technical possibilities allowing individual databases to specify and restrict the amount of data made available for common use should help to overcome existing fears of data misuse.

ZOBODAT as well as other biodiversity databases involved in these new communication programs offer their experience for other database holders willing to cooperate.

The pressure of the international community for making biodiversity data globally available increases. Therefore any improvement in the communication between databases is highly recommended. Tools for data analysis and documentation as developed by ZOBODAT could then be available for a much larger community of users.

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- Dr. Gerhard AUBRECHT, Biology-centre of the Museum of Upper Austria, J.-W.-Klein-Straße 73, A-4040 Linz/Austria, g.aubrecht@landesmuseum-linz.ac.at, www.biologiezentrum.at

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Autor(en)/Author(s): Aubrecht Gerhard

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